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(54) Multipurpose detector

(57) An event detector using an array of passive infrared detector elements, which uses interchangeable spectral filters and lenses to permit detection of a range of event types, which normally each require individual detectors with specific spectral/optical designs.

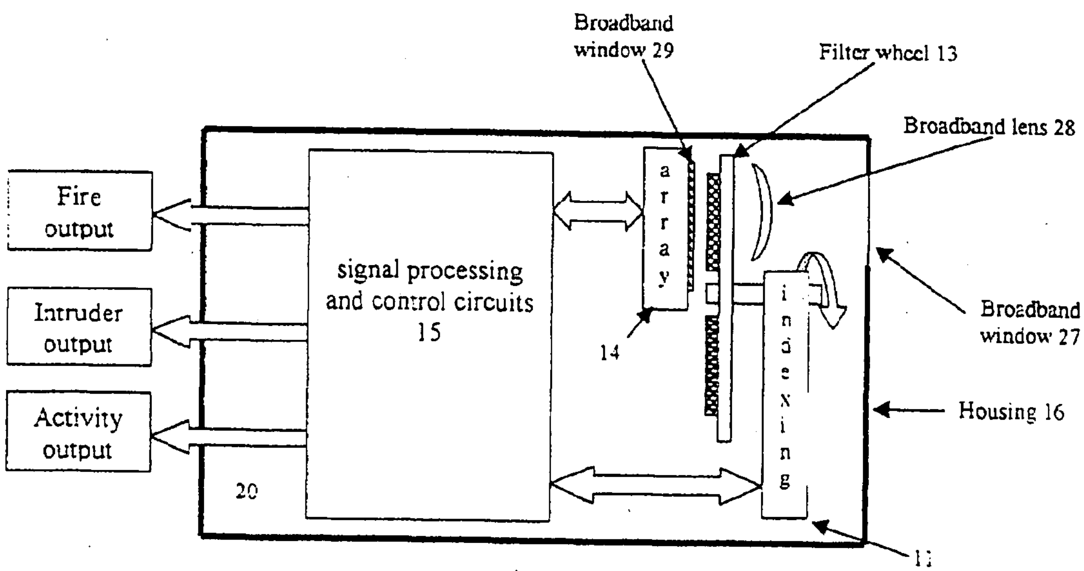

Figure 2

Description

[0001] The present invention relates to a multipurpose detector for detecting a number of different types of event.

[0002] It is known that passive infrared detectors can be used for detecting flames by detecting emissions from hot carbon dioxide using a narrow bandpass filter centred on a wavelength of 4.3 μm. By using an array of detector elements, spatial information can be obtained which permits additional information, such as the size and location of the flames, to be deduced.

[0003] Furthermore, by analysing signals from different parts of the spectrum, the performance of a flame detector can be enhanced. Typically, this is implemented by using up to three discrete detectors, each with a filter sensitive to an appropriate part of the spectrum.

[0004] It is also known that when fitted with a 5.5 μm long wave pass filter a passive infrared detector can be used to detect people. By using an array of detector elements, as in the case of the flame detector described above, spatial information can be obtained which permits additional information such as the number and location of people in the field of view, to be obtained. In addition, the detection of people can be used in a range of specific applications, e.g. door opener, intruder detector or activity monitor, by using different algorithms to implement the particular detection requirements in each case.

[0005] There has been long-term interest in detectors capable of detecting both fires and people, but the optical requirements of each of the conventional detector types have made this impractical, such that different detectors are typically used in each case.

[0006] The present invention provides a multipurpose detector comprising:

an array of passive infrared detector elements,
optical collection means for focussing broadband radiation from a scene onto the array,
means for processing signals from the detector elements, and
filtering means selectable automatically to provide a filter configuration allowing only a narrower range of radiation within the broadband to reach the detector elements.

[0007] Preferably, the filtering means provide two or more filter configurations selectable to allow different ranges of radiation to reach the detector elements. In a preferred embodiment, the selection of different ranges of wavelengths allows performance benefits to be obtained by examining different parts of the spectrum, without the need to use multiple arrays, with the inherent cost penalty and difficulties of alignment. By processing the signals from the array appropriately, it is possible to use selectable spectral information in conjunction with the spatial information from the array to provide additional functionality compared with a conventional array-based detector. For example, the combination of spatial and spectral information may be used to detect fires that are not generating flames.

[0008] In addition, in a preferred embodiment, a single detector may be used to detect entirely different events such as the presence of people and fires, by selecting different filter configurations together with appropriate signal processing and detection algorithms in each case. Such a device may be selected to operate either as a fire detector or a people detector at a particular time, or otherwise may be operable to continuously scan for both fires and people. In a further embodiment, the spatial information may be used to distinguish between allowable and unallowable events, such as the presence of fires and/or people, in particular areas of the scene.

[0009] The detector array itself typically comprises a planar or substantially planar array of individual passive infrared detector elements, which may be pyroelectric detector elements. The broadband radiation permitted to pass onto the array by the optical collection means typically comprises at least the range of wavelengths capable of being detected by the detector elements being used. For passive infrared detectors, this broadband radiation is generally within the wavelength range of 2 μm to 20 μm.

[0010] In a particularly preferred embodiment, the filter configuration is selectable in response to a control signal generated by the signal processing means. This signal may effect implementation of the available filter configurations sequentially, or may alternatively cause the selection of a particular filter configuration which may enable more information to be determined about an event occurring in the scene or enable confirmation of the type of such an event.

[0011] An embodiment of the invention will now be described by way of example only and with reference to the accompanying drawings in which:

Figure 1 shows schematically a fire detector having a selection of different filter configurations;

Figure 2 shows a combined fire and people detector;

Figure 3 shows a further embodiment of a combined fire and people detector; and

Figure 4 shows in more detail an arrangement of filters and lenses used in the embodiment of Figure 3.

[0012] Referring to Figure 1, a fire detector 10 is shown, in which an indexing mechanism 11 is used to bring different spectral filters 12, which are mounted on a rotatable wheel 13, in front of an array 14 of detector elements. The detector 10 further comprises a signal

processing and control unit 15 which receives signals from the detector array 14 and which also controls the indexing mechanism 11, preferably in dependance on the signals received from the detector array. The unit 15 also outputs a signal that contains information relating to the detection of fires. This signal may simply indicate the presence of a fire within the scene, or may contain further information regarding, for example, the location of a fire within the scene or the spread of a fire.

[0013] The detector is enclosed in a housing 16 which has a sapphire viewing window 17 which allows radiation from the scene to pass into the detector and onto the array 14 via a sapphire lens 18 and the selected filter 12. The window 17 provides environmental protection without affecting the transmission of radiation in the part of the spectrum that is of interest, and a similar window 19 is also provided to protect the array itself.

[0014] The lens 18 is positioned between the viewing window 17 and the selected filter 12, but could equally be positioned between the filter and the array. The lens is positioned to provide the appropriate field of view, and the material of the lens is chosen to allow radiation of the required range of wavelengths to reach the array. In this case, the lens is made of the same material as the viewing window 17, i.e. sapphire.

[0015] In this embodiment, the spectral filter is selected by means of the indexing mechanism 11 which positions the appropriate filter in front of the array. The rotatable wheel used in the embodiment of Figure 1 could be replaced by other suitable means for positioning the filters, which may use, for example, a reciprocating motion to change filters.

[0016] The different filters are chosen to allow activity in relevant portions of the spectrum to be more closely observed and analysed. By way of a further development, Figure 2 shows a detector 20 similar to that of Figure 1, in which the filters are chosen to allow events other than the presence of fire to be detected and analysed. (In Figures 2 and 3, identical reference numerals to those in Figure 1 indicate identical components which will not be described again). In the embodiment of Figure 2, the windows 27, 29 are broadband windows, and the lens 28 is a broadband lens made of a similar material to the windows. The lens 28 may be made of germanium covered with an anti-reflective coating. The indexing mechanism has at least three positions: a 5.5 μm long-wave pass filter, a 4.3 μm bandpass filter and an open position allowing radiation of all wavelengths passing through the windows 27, 29 and lens 28 to be seen by the array. Only the first two of these positions are shown in Figure 2.

[0017] The particular filters used in the embodiment of Figure 2 enable the detector to be used as both fire detector and a people detector. Correspondingly, different outputs are provided, as shown, for these different functions. In addition, the function of people detection can be further divided into intruder detection and activity monitoring, by using different signal processing techniques appropriate to each of these functions, even when using the same 5.5 μm filter. As shown in Figure 2, separate outputs may then be provided for the intruder detector and the activity monitor functions.

[0018] A typical mode of operation of the detector of Figure 2 will now be described. In normal operation the mechanism is in the "broadband" position, so that the array can detect any changes in incident radiation in either the flame or people detection portions of the spectrum. All changes in radiation are analysed by the signal processing and a decision made as to the most likely cause of this change, and the appropriate spectral filter is moved in front of the array. The decision-making processing may require a check to be made in another part of the spectrum. In this case the indexing mechanism is used to bring the alternative filter in place, and the resulting signals are processed to confirm or reject the decision of the first analysis.

[0019] For example, in the broadband position features indicative of flame flicker may be detected in the scene. In response to this, the control unit could select a 4.3 μm filter and check the relative amplitude of the detected flicker to confirm whether the flicker is indeed occurring in the portion of the spectrum associated with flame detection. Other filters could be selected to try to confirm that the source is a flame, or to isolate the likely cause of the detected signal.

[0020] Similarly, signals indicative of the presence of people may be detected in the broadband position. This first analysis could be made on the basis of characteristic signal amplitudes and spatial information being detected in the broadband position, and could be confirmed by examining the relative amplitude of the signals when filtered through a 5.5 μm filter.

[0021] Alternatively, it may not be necessary to perform any detailed 'first analysis', and the detector could simply begin to cycle through a range of different filters in response to the detection of any significant activity in the broadband position. Significant activity could be defined as any signal from a detector element being above a predetermined threshold, possibly for a given period of time, or a particular number of such signals being received from different elements. Using this system of cycling through different filters, the relative amplitudes of the detected signals in different portions of the spectrum may be examined to determine the likely nature of the event occurring within the scene. Other information, for example spatial information, may also be taken into account. The cycling of filters may be stopped, and a particular filter selected, once a satisfactory identification of the event has been established, in order to monitor the event in more detail.

[0022] In certain applications, it may alternatively be desirable to cycle the filters continuously in order to obtain continual information from different parts of the spectrum, or to cycle the filters continuously but only perform analysis of the received signals at particular times corresponding to the selection of particular filters.

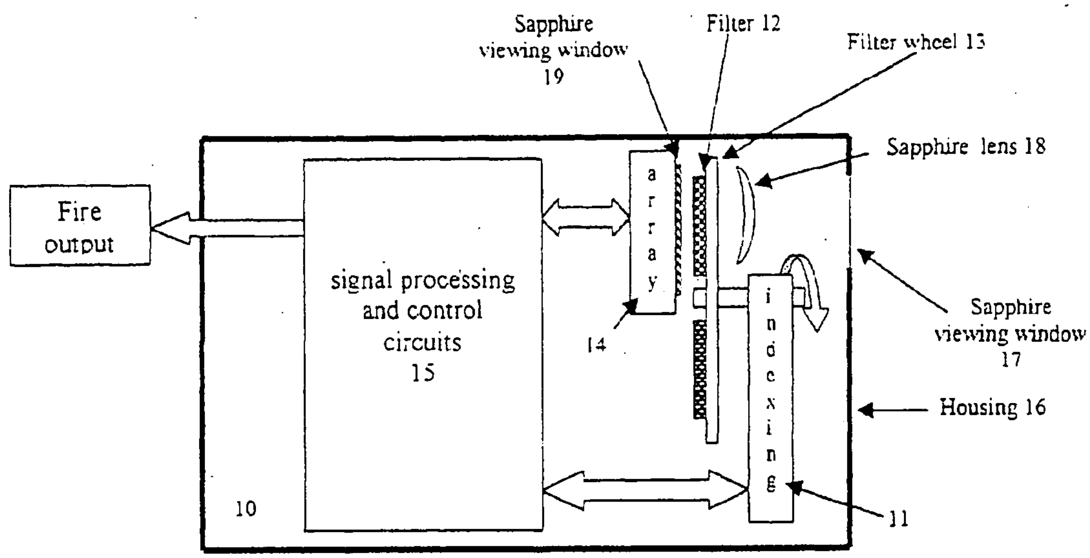

Figure 1

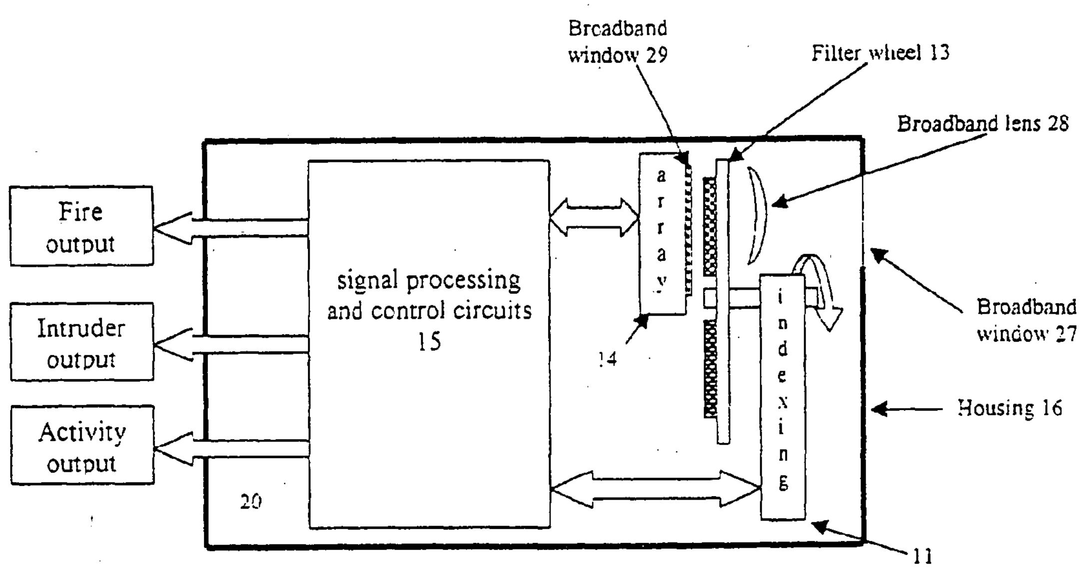

Figure 2

tical collection means are arranged to be selectable together with the filtering means.

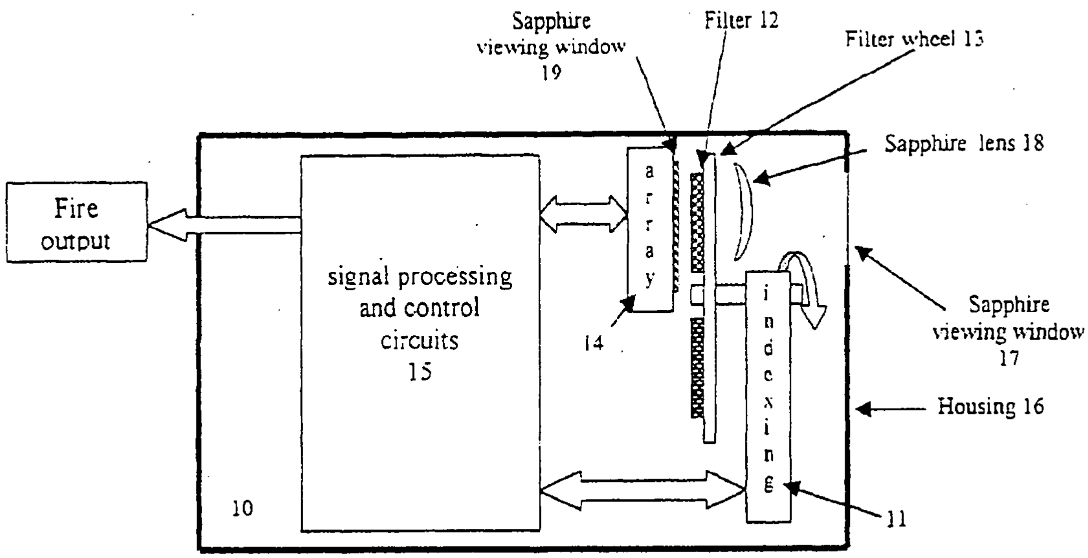

Figure 1

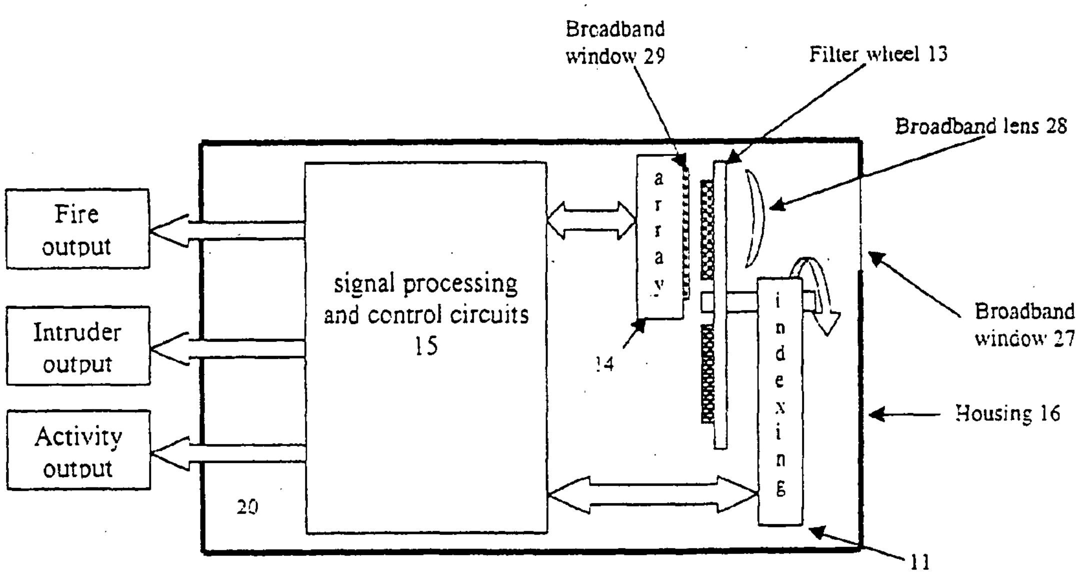

Figure 2

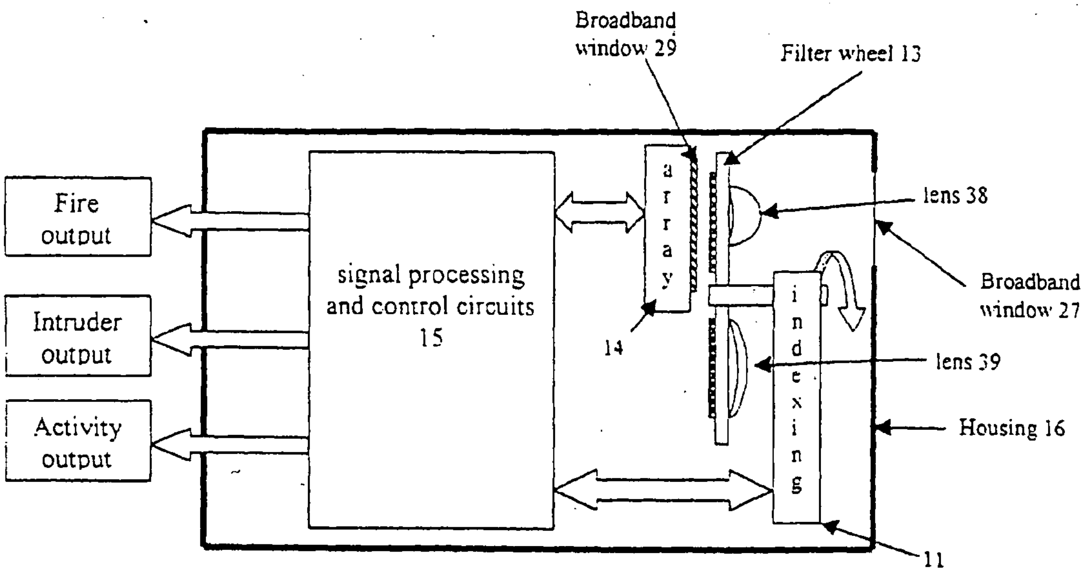

Figure 3

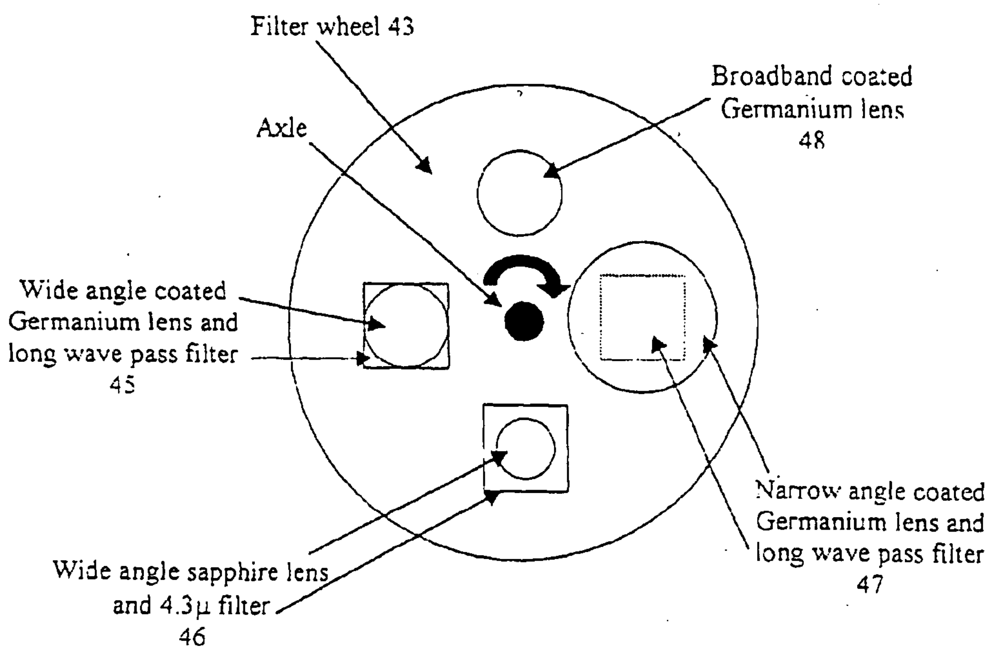

Figure 4